THE DEVELOPMENT AND INVESTIGATION OF A THEORETICAL MODEL FOR CLINICAL DECISION MAKING IN PHYSICAL THERAPY

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

1991

Dedicated with love to my Mom and Dad---
they taught me the true value of love and sacrifice
and they never quit believing in me.

ACKNOWLEDGEMENTS

After all these years, with absolute pleasure, I have an opportunity to thank people for their support. I express sincere appreciation to the members of my committee: Dr. James W. Hensel, chairman, Dr. Mary Kay Dykes, and Dr. Forrest W. Parkay for their encouragement and guidance throughout this process. I owe a special thanks to Dr. Hensel for remaining positive at all times, for never giving up on me no matter how long the effort took. I also thank Dr. Margaret K. Morgan for her support and for her advice regarding this manuscript.

I am especially grateful and indebted to two of my mentors in physical therapy education. Dr. Dorothy Pinkston faithfully supported me through this dissertation experience, and her professionalism and knowledge continually encouraged and motivated me. Dr. Katherine Shepard also served as an inspiration, providing assistance when asked, always with warmth and friendship.

I thank the people who helped with the data collection for this study and all the students who voluntarily participated in the study. Without these people the dissertation would only have been a dream.

I extend special thanks to my mom, Ruth, for her love, faith, understanding and pride, and to my dad, Warren, who is not here to see me finish, but whose love and support are with me even in his absence.

I also give heartfelt thanks to Sarah Chesrown, with whom I have shared a house and a wonderful friendship during these years of graduate work. I appreciate her unfailing support, understanding, and love during this process. Additionally, I thank all my other friends for believing in me and for their love and repeated encouragement. I especially thank Martha Wroe for willingly being my sounding board on almost a daily basis. I share my accomplishment with these special people.

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May 1991

Chairman: Dr. James W. Hensel
Major Department: Educational Leadership

The primary purpose of this study was to investigate the relationship between components of the Theoretical Model for Clinical Decision Making in Physical Therapy and the decision-making ability of students in master's degree entry-level physical therapy programs. This investigator developed the model after a review of literature revealed various theories regarding attributes required for quality decision making.

A secondary purpose was to determine any significant differences in decision-making ability among students from different physical therapy programs. Although the programs selected for the study were representative of both geographic location and institutional funding source (state versus private), each program was unique regarding the approach to teaching clinical decision making.

The subjects were 244 postbaccalaureate students from six entry-level master's degree physical therapy programs. This investigator tested four hypotheses. Three related to the model were tested by analyzing data from the six programs with five multiple regression analyses to determine the relation between a measure of verbal and quantitative knowledge, a measure of professional knowledge, a measure of analytical reasoning ability, and a measure of clinical decision-making ability. The independent variables for each analysis were the students' Graduate Record Examination Verbal plus Quantitative scores, Analytical scores, and final grade-point averages in the physical therapy program. The dependent variable was either the total score obtained on the Clinical Decision-Making Scale or the score obtained on Subscale A, B, C, or D of that instrument. These analyses, as well as Pearson product-moment correlations, revealed no significant relation ($p < .05$) between the predictor and criterion variables.

The researcher tested the fourth hypothesis by determining whether differences in decision-making ability were present in students from various physical therapy programs. The investigator analyzed data from the six programs with five one-way ANOVAs. The results indicated no significant differences, at the .05 alpha level, in performance on the CDMS among students from the six programs.

The researcher also analyzed descriptive data for all programs combined and for each separately. The study includes possible explanations for the results of all analyses and recommendations for future investigations.

CHAPTER 1

INTRODUCTION

Background of the Problem

Physical therapy faculty have long been interested in how students acquire problem-solving and clinical decision-making skills (Barr, 1977; Day, 1986; May, 1977; Myers & Rose, 1989; Shepard, 1977; van der Sijde, Sellink & Wurms,1987). Educators in other disciplines (Bloom & Broder, 1950; Ennis, 1982; Glaser, 1984; Gordon, 1966; Janis & Mann, 1977; Jenkins, 1985; Newell & Simon, 1972; Polya, 1957; Whimbey & Lochhead, 1982; Wickelgren, 1974) have shared this interest and their discussions and findings are relevant for the physical therapy educator.

Interest in decision making in physical therapy has recently heightened nationally because of the trend toward practice without practitioner referral or "direct access." Durant, Lord, and Domholdt (1989) stated: "Since 1968, 21 states have passed laws enabling physical therapists to evaluate and treat patients without a practitioner's referral. This legislation gives consumers "direct access" to the services of physical therapists" (p. 850). Magistro (1989) reminded physical therapists that this expansion of practice into more independent modes makes it imperative that

the profession educate current and future practitioners in the methods of clinical decision making.

This issue is of primary importance to the profession of physical therapy. Myers and Rose (1989) have indicated that it is time to address clinical decision making in a more formal sense, and Rothstein (1990) said that the profession seems committed to improving the clinical decision-making process, as well as to training future generations of therapists to be better decision makers. With these thoughts in mind, physical therapy faculty are striving to teach clinical decision making and problem solving.

Physical therapy programs differ, however, in the number of classroom hours devoted to helping students acquire problem-solving and clinical decision-making skills, and a few programs actually have separate courses on these topics. The document, Evaluative Criteria for Accreditation of Education Programs for the Preparation of Physical Therapists (APTA,1990a) does not mandate methods or number of hours required to cover problem solving and decision making. Faculty may design their curricula in any manner, resulting in a variety of approaches to these topics and major differences among programs.

Problem solving and clinical decision making are interrelated and often confused with each other. Taylor (1965) perhaps oversimplified the difference between the two terms when he stated that "problem solving is that thinking which results in the solution of problems," and "decision making is that thinking which results in the choice among alternative courses of action . . ." (p. 48). For the purposes of this paper, the researcher uses an expansion of Taylor's definitions: Problem solving is the process of analytical reasoning and knowledge recall necessary for the effective solution of problems, and clinical decision making is the steps one goes

through, mentally and physically, to gather and analyze necessary information and to choose among alternative courses of action to make a decision regarding a client. Although problem solving and clinical decision making are clearly two different concepts, they definitely have overlapping aspects and problem solving is implicit in clinical decision making.

A review of the literature revealed that educators differ in theories about what abilities are necessary for effective problem solving and decision making. Some believe that skill in the heuristic process is the key element (Whimbey & Lochhead, 1982; Wickelgren, 1974), whereas others (Chase & Simon, 1973; Glaser, 1984) purport knowledge to be the alpha element. Polya (1957) and Taylor (1965) discussed a third theory that indicates content knowledge and the heuristic process are equally important. Additionally, Glaser (1984) stated that "high-aptitude individuals appear to be skillful reasoners because of the level of their content knowledge as well as because of their knowledge of the procedural constraints of a particular problem form, such as inductive or analogical reasoning" (p. 99).

These relationships between logical and analytical reasoning ability, level of knowledge, and skill in the heuristic process are important for physical therapists to understand because both problem-solving and decision-making abilities are considered required skills for the effective physical therapy clinical practitioner (May, 1984; Tammivaara & Yarbrough, 1984).

To illustrate and investigate these relationships, the investigator developed and tested the Theoretical Model for Clinical Decision Making in Physical Therapy (Figure 3-1). The model grew out of various theories purported in the literature regarding the key attributes for decision making. Chapter 3 contains a detailed explanation of the development of the model,

a model that incorporates all three attributes discussed in the literature--knowledge, analytical reasoning, and the heuristic process.

Evaluation of clinical decision-making skill for the physical therapist is difficult because, to date, no one has published an instrument to measure clinical decision-making ability in physical therapy and other health care disciplines have perfected few such measures. Faculty in physical therapy have traditionally measured students' knowledge related to problem solving and decision making by using content examinations at intervals throughout the students' course of study. Measurement of the clinical decision-making process, though, is more complex than measurement of content. Physical therapists have, however, devoted much energy to the process of understanding what is involved in clinical decision making and how to teach it. Wolf (1985) included chapters devoted to decision analysis, clinical decision making, and decision making in various physical therapy speciality areas. Although Wolf and others discussed numerous aspects of the clinical decision-making process, they presented no tools or procedures for quantifying the level of skill in clinical decision making.

Burnett and Pierson (1988) discussed classroom activities designed to enhance problem-solving skills in physical therapy, and Rothstein and Echternach (1986) introduced the hypothesis-oriented algorithm for physical therapy clinicians (HOAC). They designed this device to help physical therapists in clinical decision making and patient management. Payton (1985) published results of a study showing that the clinical problem-solving sequence used by physical therapists was similar to a method that physicians have used. None of these authors included a tool that could be used to measure the clinical decision-making process.

Jenkins (1985), however, published a tool to measure the clinical decision-making ability of nurses. She developed the Clinical Decision Making in Nursing Scale (CDMNS) to measure how nursing students perceived their own clinical decision-making ability. Jenkins later revised the Likert-type answer scale descriptors to better reflect behavior rather than perceived ability. Other nurses have since used the CDMNS to investigate the decision-making process and published these studies in a master's thesis (Engberg, 1987) and a doctoral dissertation (McFadden, 1987).

Although developed for use in nursing, the CDMNS is not specific to nursing professionals, and therefore could be used to evaluate clinical decision-making ability for other health professionals. No investigators have published studies involving the use of the CDMNS by other health professional faculty.

Statement of the Problem

The problem has two aspects. Decision making is considered a required skill for effective clinical practice in physical therapy, and a tool for measuring clinical decision-making abilities of physical therapists has not been documented. The second aspect is that educators differ regarding the importance of various attributes as they relate to problem-solving and decision-making abilities. To date no theorist has developed and tested a theoretical model for clinical decision making in physical therapy. This investigator addressed both aspects of the problem in this prospective cohort study.

Purpose of the Study

In order to understand the factors influencing the process of clinical decision making in physical therapy, this investigator developed a theoretical model (Figure 3-1) that included the following components: (a) general and professional knowledge, (b) analytical reasoning skill, and (c) heuristic process skill. The purpose of the study was to investigate the relation between these components of the model and the clinical decision-making ability of students in master's degree entry-level physical therapy programs. The independent variables for the study were (a) a measure of analytical reasoning, (b) a measure of verbal and quantitative knowledge, and (c) a measure of professional knowledge; the dependent variable was a measure of clinical decision-making ability. The independent variables were operationally defined, respectively, as (a) students' scores on the Analytical (GRE-A) portion of the Graduate Record Examination, (b) Verbal and Quantitative (GRE-VQ) scores on the general portion of the Graduate Record Examination (verbal plus quantitative score), and (c) final grade-point averages (GPA) in the master's degree entry-level physical therapy professional education program. The students' scores on the Clinical Decision Making in Nursing Scale (CDMNS) became the operational definition of the dependent variable.

A secondary purpose of the study was to determine whether graduates from different physical therapy programs and, therefore, with different degrees of formal instruction in problem solving and clinical decision making performed differently on the CDMNS.

Research Questions

This investigator designed the first three research questions posed in this study to investigate the relation between components of the Theoretical Model for Clinical Decision Making in Physical Therapy (Figure 3-1) and the clinical decision-making ability of physical therapy students. A fourth research question was designed to determine whether graduates from these various physical therapy programs differed in decision-making ability. Note that the variables chosen to represent components of the model are as follows: (a) students' CDMNS scores represent clinical decision- making ability; (b) students' GRE-A scores represent analytical reasoning ability; (c) students' GRE-VQ scores represent verbal and quantitative knowledge; and (d) students' GPAs represent the didactic portion of professional knowledge.

Looking at students just prior to graduation from master's degree entry-level physical therapy programs, the investigator asked these four research questions:

1. Is there a relation between posttraining CDMNS scores (total or individual subscale) and pretraining GRE-A scores after controlling for GRE-VQ scores and GPA?

2. Is there a relation between posttraining CDMNS scores (total or individual subscale) and pretraining GRE-VQ scores after controlling for GRE-A scores and GPA?

3. Is there a relation between posttraining CDMNS scores (total or individual subscale) and final GPA obtained for the physical therapy program after controlling for GRE-VQ and GRE-A scores?

4. Is there a difference in performance on the CDMNS among students of selected master's degree entry-level physical therapy programs?

Significance of the Study

The heightened interest in problem solving and clinical decision making among physical therapy educators and the continuing debate among educators regarding the important attributes for quality decision making, intensified the need for the development and testing of the Theoretical Model for Clinical Decision Making in Physical Therapy (Figure 3-1). The study was performed to end the debate over which attributes--knowledge, analytical reasoning ability, and/or heuristic process--are most important for quality decision making in physical therapy. This study also adds to the current knowledge regarding clinical decision-making ability of physical therapy students by documenting that ability with a quantifiable instrument. The analysis of performance among students from different programs is relevant for curriculum design and for clinical practice.

Assumptions

The assumptions underlying this study were as follows:

1. Graduates of physical therapy programs need to be able to problem solve and to make sound clinical decisions.

2. Analytical reasoning is a necessary element for problem solving and clinical decision making in physical therapy.

3. Verbal and quantitative knowledge are necessary elements for problem solving and clinical decision making in physical therapy.

4. Professional knowledge is a necessary element for problem solving and clinical decision making in physical therapy.

5. Scores on the CDMNS represent clinical decision-making heuristic process ability.

Limitations of the Study

Three specific limitations have a direct impact on this study:

1. Random selection of subjects was impossible. An attempt was made to obtain a representative sample by using subjects from six physical therapy programs from various regions of the country, but since randomization was not used, representation cannot be absolutely assured.

2. Generalization is limited to that population of individuals who are at the point of completing a master's degree as the first professional degree in physical therapy. (The first professional degree can be either a baccalaureate or a master's degree, and the choice varies among programs.)

3. Because the CDMNS is a self-report instrument, there was concern about respondents indicating their perceived versus actual patterns of decision-making behavior. To help alleviate this problem, the investigator assured respondents of their anonymity and requested that they respond on the basis of their actual behavior while in a clinical setting. She assured them that the instrument had no "right" or "wrong" answers.

Definition of Terms

The investigator defined the following terms for use in this study:

1. Problem solving is the process of analytical reasoning and knowledge recall necessary for the effective solution of problems.

2. Client refers to a health care consumer.

3. Clinical decision making is defined as the steps one goes through, mentally and physically, to gather and analyze necessary information and to choose among alternative courses of action to make a decision regarding a client.

4. Heuristic process is the use of rules or steps when making a clinical decision.

5. Professional knowledge is the physical therapy knowledge acquired while attending a physical therapy program and any time thereafter.

6. Analytical reasoning is the ability to understand the relations between persons, places, things or events and to deduce new information from those relations. Additionally, it is the ability to think analytically and logically, including the ability to understand, analyze, and evaluate arguments.

7. Grade-point average is the average for all didactic work accomplished in the physical therapy program with a possible range of 1.00 - 4.00.

CHAPTER 2

REVIEW OF LITERATURE

This chapter contains a review of literature relevant to problem solving and decision making. This review is to clarify related terms, demonstrate relevance to the health professions, especially to physical therapy, and describe published efforts to measure problem-solving and clinical decision-making ability. Additionally, this chapter contains a review of applicable literature on the use of the Graduate Record Examination and the Clinical Decision Making in Nursing Scale. For clarity Chapter 3, Model Development, contains a review of literature pertaining to theories of required attributes for problem solving and decision making.

Problem Solving, Critical Thinking, and Decision Making -- A Clarification of Terms

The literature contains many definitions of problem solving, critical thinking, and decision making. Because the public often uses these terms interchangeably, leading to confusion, mention of all of them is appropriate. Chipman (1985) defined problem solving as the use of previously acquired knowledge and skill to deal with new situations. Bruner (1964) described problem solving as a cycle that includes formulating a testing procedure,

operating a testing procedure, and comparing the results of the test with some criterion.

Kurfiss (1988) discussed both problem solving and critical thinking, stating that the two are interrelated and discussing the differences between them. She defined critical thinking as a form of problem solving that involves reasoning about open-ended problems or problems with no single solution, while she considered problem solving to be more narrow in scope because a correct solution usually exists. She said that problem solvers analyze the current state of the situation, "identify constraints, gather information, generate one or more hypotheses, and test their hypotheses until the goal is achieved" (p. 29).

Ennis (1982) described critical thinking as "the correct assessing of statements" (p. 83). He further listed what he believed to be 12 aspects of critical thinking:

1. Grasping the meaning of a statement.
2. Judging whether there is ambiguity in a line of reasoning.
3. Judging whether certain statements contradict each other.
4. Judging whether a conclusion follows necessarily.
5. Judging whether a statement is specific enough.
6. Judging whether a statement is actually the application of a certain principle.
7. Judging whether an observation statement is reliable.
8. Judging whether an inductive conclusion is warranted.
9. Judging whether the problem has been identified.
10. Judging whether something is an assumption.
11. Judging whether a definition is adequate.
12. Judging whether a statement made by an alleged authority is acceptable. (p. 84)

Ennis considered these twelve overlapping aspects to be characteristic of a critical thinker and he saw the need for further study in how to integrate the teaching of critical thinking into a curriculum. These aspects of critical

thinking are clearly related to problem solving and involve the knowledge and mental skills needed for the solution of problems.

Champagne and Klopfer (1977) discussed reflective thinking as yet another term related to problem solving. They advocated that innovative problem solving is the external manifestation of reflective thinking. Shulman and Elstein (1975) stated that "the essence of learning is not merely doing, but thinking about what one is doing" (p. 37). Taylor (1965) also discussed the complexities of decision making, problem solving, and creative thinking and stated that "creativity is that thinking which results in the production of ideas (or other products) that are both novel and worth while" (p. 48). He defined problem solving simply as "that thinking which results in the solution of problems" (p. 48) and decision making as "that thinking which results in the choice among alternative courses of action" (p. 48). A more thorough definition of these terms is as follows: Problem solving is defined as the process of analytical reasoning and knowledge recall necessary for the effective solution of problems. Clinical decision making is defined as the steps one goes through, mentally and physically, to gather and analyze necessary information and to choose among alternative courses of action to make a decision regarding a client.

Problem Solving and Clinical Decision Making in Physical Therapy and Other Health Related Fields

Physical therapists have commented on the importance of effective problem-solving and clinical decision-making abilities for the physical therapist. Tammivaara and Yarbrough (1984) interviewed 22 persons regarding the field of physical therapy. One particular topic involved the

perceived characteristics of competent physical therapists. They found problem-solving ability to be a general category common to most descriptions of a competent physical therapist. One particular description of competent physical therapists is as follows:

> They are excellent problem solvers. They take their background knowledge, theories, and principles and can, in a relatively short period of time, come up with and generate, numerous alternatives to a problem, whether that problem be an administrative, . . . managerial, . . . or patient problem . . . Based on their problem solving abilities they can recognize when something is or is not working and can . . . revise the program without having anxiety that it's not a good idea to try something new. (p. 26)

Shepard and Jensen (1990) alluded to the importance of a special kind of problem solving in their discussion of the physical therapist as a "reflective practitioner." They emphasized that therapists must use a "reflective" or "intuitive" knowledge in order to practice in what Schon called "the indeterminate zones of practice." Schon (1987) stated that these indeterminate zones of practice are "uncertainty, uniqueness, and value conflict" (p. 6). Day (1986) identified "an assumption that the ability to solve problems and to analyze new situations is paramount to good performance by a physical therapist" (p. 1555). She investigated the use of the Graduate Record Examination (GRE) analytical scores as predictors of success in physical therapy programs. Her results indicated the GRE analytical scores were significant predictors of final grade-point averages for master's degree entry-level physical therapy students.

May and Newman (1980) stated that "students enter physical therapy curricula with a developed approach to problem solving and unconsciously use that approach in solving problems related to physical therapy practice with varying degrees of success" (p. 1140). May (1984) later emphasized that students need learning experiences involving problem solving, self-

direction, and self-learning in order to prepare them to be competent physical therapy practitioners.

Because physical therapists need to problem solve and make clinical decisions, several physical therapists have published in the areas of problem-solving curriculum design and problem-solving methods or strategies for use in the classroom. Johnson (1974) wrote about curriculum design for physical therapy education and predicted that physical therapists might need to prepare for independent practice. To enable the physical therapist to practice independently of the physician, she indicated the need to prepare the physical therapist "as a health care practitioner responsible and accountable for decisions and actions in delivering care" (p. 384).

May (1977) discussed a design for an integrated problem-solving curriculum for physical therapy education. She identified the need for problem-solving learning experiences to help students develop skills in problem solving. Students who graduated from her program commented that they felt well prepared for any situation and that they felt they knew how to problem solve when in the clinic. May (1988) later commented on problem-based learning, saying that one of the goals of such a curriculum design is to help students function as effective problem solvers. She stated:

> structuring learning experiences around real-life clinical situations enables students to learn decision-making skills in the relative safety of the classroom. Problem solving and decision making are not identical processes, and the use of a problem-based approach can provide students with greater opportunities for decision making than the more traditional subject-matter approach. (p. 528)

Barr (1977) described another problem-solving curriculum design in physical therapy that included such advantages as preparing the learner to

deal effectively with unknown physical therapy problems in the future. Chipman (1985), a general educator, supported this concept by stressing that problem solving is the use of previously acquired knowledge and skill to deal with new situations. Barr (1977) identified seven basic assumptions that underlie a problem-solving curriculum in physical therapy:

1. The physical therapist is a problem solver.
2. Problem-solving skills utilized by physical therapists can be taught and learned.
3. Problems from physical therapy can be used as organizing centers for learning activities.
4. Problem-solving and affective abilities can be applied in any of the settings or roles in which physical therapists function.
5. There can be concurrent learning of content and process, as well as development of affective abilities.
6. A problem-solving approach will facilitate transfer of knowledge and continued learning which are dependent upon application to and practice with similar, but different problems.
7. A problem-solving curriculum design in physical therapy will overcome some of the inadequacies of the traditional, subject-centered design. (p. 263)

Olsen (1983) described an operational problem-solving model developed and used by the faculty in the physical therapy curriculum at the University of Puget Sound to help provide problem-based learning in a subject oriented curriculum. Students and faculty believed the model to be useful in achieving that goal. Olsen's model involved the following components:

1. Problem

   Identify the patient's problem.

2. Cause

   Describe the causes of the problem.

3. Principle

   The principle is divided into three parts:

   a) Method--Select a way to deal with the problem.

b) Solution--Identify the mechanism the method will have on the cause.

c) Product --Identify expected outcomes.

4. Modality

   Use a therapeutic intervention.

5. Goal

   Set a goal for the patient. The patient meets it or does not meet it.

May and Newman (1980) wrote that "problem solving is an integral part of effective physical therapy practice" (p. 1140) and presented an operational model that depicted the cognitive, affective, and psychomotor behaviors of the problem solver when solving problems. This is the sequence of activities of the model:

1. Problem recognition
2. Problem definition
3. Problem analysis
4. Data management
   a) Data collection methods selection
   b) Data collection
5. Solution development
   a) Data analysis
   b) Alternative solution determination
   c) Solution selection
6. Solution implementation
7. Outcome evaluation

Burnett and Pierson (1988) discussed activities designed to help first-year physical therapy students develop problem-solving skills in the

classroom. The format of their class sessions and activities evolved over a three-to-four year period. They found that many students were unenthusiastic and uncomfortable with problem solving and suggested that the student's level of cognitive development was one of the main influences of that attitude .

Rothstein and Echternach (1986) introduced an hypothesis-oriented algorithm for clinicians (HOAC) that was designed to help physical therapists with clinical decision making and patient management. The HOAC requires the therapist to document all actions taken as well as all underlying rationales and the instrument consists of two parts. "The first part is a sequential guide to evaluation and treatment planning. The second part involves a branching program that anticipates the clinical decisions that must be made" (p. 1389).

Burnett, Mahoney, Chidley, and Pierson (1986) described the use of a problem-solving method to structure a clinical experience for first-year physical therapy students. Their method included the presentation of patient case studies to seven groups of 10 students. The clinical instructor helped the students in identifying problems, in goal setting, and in developing alternative treatment plans for the patient. The authors did not collect statistical data to demonstrate improvement of problem-solving skills of the students. However, both students and clinicians subjectively reported that the experiences were worthwhile.

Slaughter, Brown, Gardner, and Perritt (1989) reported the results of a study in which they used the Watson Glaser Critical Thinking Appraisal (CTA) and participant feedback to assess the effectiveness of a model for teaching problem-solving skills to first-year physical therapy students. They used a pretest-posttest control design. Students in the experimental group

used a problem-solving model during a four-week clinical practicum. Although the investigators found no significant difference in performance on the CTA between the experimental and control groups, subjectively students and clinical instructors in the experimental group found the model to be effective in aiding students' understanding of patient assessment and treatment program planning. The authors emphasized the need for a valid instrument to measure progress in physical therapy students' problem-solving skills.

Van der Sijde, Sellink, and Wurms (1987) developed an audiovisual training program in problem-solving skills for physical therapy students. They used a series of structured videotaped case histories at three levels of learning in their curriculum--year one, year two, and years three and four. These case histories were designed to introduce different elements of problem solving at the three levels with the third level requiring the most skill. They reported favorably regarding the effectiveness of the audiovisual approach as a tool for physical therapy education.

These publications in the physical therapy literature are documentation of the interest in problem solving and clinical decision making in physical therapy. The relative newness of the concept of clinical decision making to physical therapy is noteworthy. Echternach and Rothstein (1989) reviewed the physical therapy literature in preparation for an article related to clinical decision making. They found that clinical decision making was not a subject topic used in the Sixty-Five Year Index to Physical Therapy (APTA, 1986a) or in the yearly subject index of Physical Therapy through 1988 (APTA, 1986b-1988). Physical therapists have indeed published in the area of problem solving and have delivered lectures at professional meetings on the issues of problem solving and decision

making, but clinical decision making has not been considered a main topic as evidenced by the sparsity of entrees in the major physical therapy indices.

This topic, however, is one that physical therapists now believe should be examined in a more formal sense (Myers & Rose, 1989), and one that has become of national interest due to the increasing numbers of states that allow physical therapists to evaluate and treat patients without a practitioner's referral. At a conference on Clinical Decision Making in Physical Therapy Practice, Education, and Research, Myers and Rose (1989) commented on the importance of formal instruction in clinical decision making when they stated that " the primary objective of the conference was to begin the preparation for the introduction of clinical decision making into the curricula of education programs for the physical therapist" (p. 523).

Magistro (1989) emphasized the importance for all physical therapists to be able to make sound clinical decisions. He believed skill in decision making to be necessary because of the trend for the profession of physical therapy to move toward a role of increased independence or "direct access." He also pointed to the need for physical therapists to gain a greater understanding of the clinical decision-making process itself.

Several investigators in the fields of medicine, nursing and physical therapy have provided some insight into this process, but none have published a theoretical model that demonstrates the elements necessary for quality decision making. Payton (1985) reported on a study in which ten skilled physical therapist clinicians were observed as they performed an initial interview with a patient. These interviews were audiotaped and later analyzed. Payton found that the clinical problem-solving sequence used by

these therapists was comparable to methods reported in the literature by Barrows and Bennett (1972) and Elstein, Kagan, Shulman, Jason, and Loupe (1972) that physicians use. He recommended further study to determine whether less skilled therapists use the same clinical reasoning process as the skilled therapists.

The clinical reasoning process Elstein, Shulman, and Sprafka (1978) described included four steps: cue acquisition, hypothesis generation, cue interpretation, and hypothesis evaluation. These authors stated that differences in the content knowledge stored may distinguish the stronger from the weaker problem solver, but that medical problem solving does not depend solely upon mastery of content recall. Also, medical problem solving requires gathering additional data, evaluating those data, redefining problems, and exploring alternative interpretations.

Wales, Nardi and Stager (1986) gave another description of professional decision making. They emphasized a pattern of four operations for professional decision making: (a) state the goal, (b) generate ideas, (c) prepare a plan, (d) take action. The authors combined these operations with a hierarchy of thinking that included analysis, synthesis and evaluation, into a 12-step process designed to help one understand how to solve problems.

Watts (1989) reported on a systematic method for making clinical decisions in physical therapy that she called clinical decision analysis. Raiffa (1968) originated the method at Harvard Business School. It has been adapted for use in the medical field. As adapted for physical therapy, the clinical decision analysis involves six major steps:

1. Defining the decision problem
2. Defining successful and unsuccessful outcomes
3. Describing alternative approaches and their consequences

4. Estimating and analyzing probabilities
5. Estimating costs
6. Selecting a preferred strategy

Watts said that this method is not practical for making most decisions in everyday clinical practice, but should be used selectively "for decisions that are made frequently, have important consequences, and provoke some sort of controversy, uncertainty, or discontent with the results less formal decision making achieves" (p. 576). She also believed that decision analysis does not always need to include all component steps to be useful.

Measurement of Problem-Solving and Clinical Decision-Making Ability

Another concern in the health professions is how to measure problem-solving or decision-making ability. Marshall (1977) described the use for physicians of patient management problems (PMPs) which are produced in booklet format with the information needed to solve the problem concealed through the use of invisible ink. He said that the highest marks in PMPs are achieved by those candidates who arrive at the correct diagnosis in the most efficient fashion and, further, that the PMP may then be measuring efficiency in problem-solving ability.

Goran, Williamson, and Gonnella (1973) reported the results of a study that raised questions of the validity of the PMPs. In their study they focused on a single medical problem and involved 22 university clinic teams. The investigators compared teams' performance with actual patients with their performance on a simulated PMP. The investigators found that the PMP did not provide a valid discrimination of adequate clinical performance. Marshall (1983) confirmed problems with PMPs. He suggested that PMPs

are not a measure of total clinical competence, but "should be used to address only one aspect of this complex issue--that of problem solving per se" (p. 321). Newble, Hoare, and Baxter (1982) also cautioned users of the PMPs to remember "that written PMPs cannot yet be regarded as a valid simulation of clinical performance" (p.137). They stated that while content validity is high, this is not true for construct validity or concurrent validity.

Barrows and Tamblyn (1980) discussed the evaluation of problem based learning and clinical reasoning ability. They emphasized the importance of matching the tool for evaluation to the behavior or competency to be tested and recommended several tools to look at the intermediate steps and the total product of the clinical reasoning process. One example was time-out discussions during the use of simulated patients where the student's thought processes could be dissected. Barrows and Tamblyn (1980) also noted the paucity of "evidence that the amount of factual knowledge possessed by a student, as scored by objective examinations, correlates in any way with clinical competence " (p. 6).

Helfer and Slater (1971) used another type of instrument called the Diagnostic Management Problem (DMP) to measure the problem-solving process used by medical students. They compared the scores received on the DMP by a group of students with scores received on Patient Management Problems by the same group of students and found the correlation for this comparison to be .60 ($p = .01$). They concluded that the instrument was reliable for measuring the process a student uses to arrive at a clinical diagnosis.

Vu (1980) published a thorough review of the medical literature on problem solving and discussed several important issues. Two of these were the possibility of identifying potential deficiencies in problem-solving

ability early in the medical curriculum, and identification of instruments that could be used to predict these deficiencies. He found a need for future studies since the studies he reviewed used different predictors and defined their criteria differently. For these reasons, he felt that broad generalizations and comparisons were not feasible.

McGuire (1985) critiqued the literature on medical problem solving and commented that researchers believed it was not possible to generalize problem-solving performance across problems. She felt that a large portion of the cognitive process involved in decisions about patient care is still unknown.

Aspinall and Tanner (1981) developed a model of the thinking processes of clinical problem solving in nursing. Their problem-solving process included the generation of multiple alternatives and the systematic testing of those alternatives against additional information gathered from the patient and other sources. On the other hand, del Bueno (1983) used simulations to teach and assess the clinical decision-making skills of nurses. Her study involved both experienced and inexperienced registered nurses who had graduated from three types of educational programs--bachelor of science in nursing, associate degree in nursing, and diploma in nursing. She reported that both experience and the baccalaureate preparation correlated positively with the correct decisions.

To date, no one has published an instrument to measure problem-solving and/or clinical decision-making skills used in physical therapy. Wolf (1985) included chapters devoted to decision analysis by Watts, clinical decision making by Hislop, and decision making in various physical therapy speciality areas by other authors. Although these authors discussed numerous aspects of the clinical decision-making process , they presented

no tools or procedures for quantifying the level of skill in clinical decision making.

The nursing profession has made progress in this area. Jenkins (1985) published information about the Clinical Decision Making in Nursing Scale (CDMNS) that she developed to measure how nursing students perceive their own clinical decision-making ability. She later revised the Likert-type answer scale descriptors to better reflect behavior rather than perceived ability. Other nurses have since used the CDMNS to investigate the decision-making process. Engberg (1987) published such a study in a master's thesis and McFadden (1987) in a doctoral dissertation.

Instruments Selected for Use in Study

Clinical Decision Making in Nursing Scale

The Clinical Decision Making in Nursing Scale (CDMNS) was developed by Jenkins (1985) to study the perceptions of clinical decision making in nursing students. The instrument was developed with normative decision making and self-perception theory as the theoretical base. The work of Janis and Mann (1977) was the basis for tool construction and the model of decision making they chose was a normative one. Jenkins (1985) condensed Janis and Mann's seven criteria into four categories of decision making:

1. search for alternatives and options
2. canvassing of objectives and values
3. evaluation and reevaluation of consequences
4. search for information and unbiased assimilation

These four categories became the four subscales of the instrument. Items for the CDMNS were gathered from relevant managerial and nursing literature and from decision theory and, after the items were generated, they were subjected to validity and reliability procedures (Jenkins, 1985).

Jenkins (1985) reported on a study that involved pretesting, pilot testing, and formal testing of the instrument. The formal testing included 111 nursing students who were engaged in clinical practice at the end of a semester of study. Of the 111 students, 27 were sophomores, 43 were juniors, and 41 were seniors. The author found no significant differences among sophomores, juniors, and seniors except on Subscale A--Search for Alternatives or Options. The difference in mean scores on this subscale between juniors and seniors was significant, with seniors having the higher mean score. Jenkins (1989) recommended further study in this area and suggested replication of the study using the CDMNS with other groups and comparing the CDMNS with other measures.

McFadden (1986) used the CDMNS to investigate 153 senior nursing students' perceptions about their clinical decision making and the relation of these perceptions to learning style, personality type, and age, sex, education, college career choice, and nursing work experience. She reported no significant relation between CDMNS scores and learning style, age, sex, education, or work experience. She did find a weak positive relation between the Sensing/Intuitive scale of the Myers Briggs Type Indicator and CDMNS scores and an inverse relation between the Extravert/Introvert scale and CDMNS scores. Her reported Cronbach's alpha was 0.80.

Engberg (1987) studied the relation between scores obtained on the CDMNS and accuracy in solving a videotape simulation of a clinical

problem for 31 registered nurses. She found no significant relation between the two, and reported a Cronbach's alpha of 0.93.

Jenkins gave written permission for this investigator to change the name of the CDMNS for this study to Clinical Decision Making Scale (CDMS). The rationale was that omitting the word Nursing would make the instrument less confusing for physical therapists.

Graduate Record Examination (GRE)

The Educational Testing Service developed and publish the GRE. Graduate schools use scores on it, along with other data, to predict academic success. "Research to date indicates that GRE scores are valid predictors of success in the first year of graduate school for all students" (p. 14, ETS, 1990).

Traditionally, the GRE General Test has included verbal (GRE-V) and quantitative (GRE-Q) measures. The analytical (GRE-A) measure is the newest of the three measures of the current General Test. The ETS instituted the analytical measure in October, 1977 and revised it for use beginning in October, 1981. The revised instrument includes items to test analytical and logical reasoning (ETS, 1990).

Several investigators have considered the predictive validity of the analytical measure. Mowsesian and Hays (1982) examined the efficacy of the GRE-A score as a predictor for admission to a graduate program in educational psychology. They reported that when GRE-A scores were used in combination with a student's grade-point averages, GRE-V scores and GRE-Q scores, the GRE-A contributed little to the total predictive ability of the variables. Independently, however, the GRE-A scores were as reliable as any of the other scores.

Mowsesian and Hays (1984) reported the GRE-A scores to be a useful predictor for the selection of doctoral candidates in an educational psychology department. Using a step-wise regression analysis with 23 predictor variables, the authors found the GRE-A score to be in a group of nine variables that accounted for 70 % of the variance in the predictors (r^2 = .697). When the investigators analyzed only quantitative predictors, the GRE-A score and the grade-point average, taken together, accounted for 23 % of the total variance (r^2= .225).

Mowsesian and Hays (1985) compared the earlier experimental format of the GRE-A with the current format. They analyzed data on 407 students who applied for admission to a graduate program in educational psychology. They used regression analysis of the independent variables, GRE-V, GRE-Q and GRE-A measures, along with sex, ethnic status, area of specialization, faculty evaluation of Ph.D. qualification, and demographic data to attempt to account for a significant variance associated with admissions decisions. They found the GRE-V and GRE-Q scores accounted for more variance than the GRE-A score, but that the GRE-A score did add to the prediction of advancement to Ph.D. candidacy and they concluded that the GRE-A measure had predictive utility for admissions decisions regardless of format.

Kingston (1985) reported results of a study of 2,146 students in 158 departments. He concluded that the analytical measure was not significant over the GRE-V and GRE-Q measures in predicting graduate first-year GPA with the possible exception of students in engineering and physical-mathematical sciences programs.

Day (1986), in a study of four master's degree entry-level physical therapy programs, analyzed data on a total of 121 students who had taken

the 1981 revised format of the GRE-A measure. Analysis of results indicated the GRE-A score to be significant ($p < .05$) in predicting the final GPA of students in this group. The GRE-A score was also a significant predictor in Program A ($p < .05$) when the researcher analyzed data from programs individually.

In an unpublished follow-up study of the same four master's degree entry-level physical therapy programs, Day (1987) analyzed data on a total of 234 students. She found that when she combined data from all programs the GRE-A score and overall GPA remained significant predictors of final GPA. In two of the four individual programs the GRE-A score was also a significant predictor.

Summary

This review of literature in the area of problem solving and decision making contains the following points:

1. Many persons confuse the terms problem solving, decision making, reflective thinking, critical thinking, and clinical reasoning. The literature contains many examples of the interchangeable use of the terms.

2. Problem-solving and clinical decision-making skills are important to the field of physical therapy, and physical therapy educators have devoted great effort to curriculum design and teaching methods to help students acquire these skills.

3. Physical therapists have recently become increasingly interested in clinical decision making, in part due to the movement of physical therapists toward practice without physician referral (direct access).

4. To date, investigators have documented no theoretical models for clinical decision making in physical therapy.

5. To date, they have documented no instrument for measuring clinical decision-making ability in physical therapy.

6. Problem solving and decision making are topics of interest in other health professions and nursing has developed an instrument for measuring clinical decision-making ability for nurses.

This chapter does not contain a review of theories regarding required attributes for quality decision making. As stated in the introduction to this chapter, this review is in Chapter 3, Model Development.

CHAPTER 3

MODEL DEVELOPMENT

Introduction

As discussed in the review of literature in Chapter 2, physical therapists believe skills in problem solving and clinical decision making to be paramount for quality practice. Although the two skills are separate by definition, to separate them in actual practice is difficult and problem solving is usually implicit in clinical decision making. Educators have published much about problem solving and decision making but they differ in opinion regarding the required attributes for these skills.

The review of the literature revealed three primary theories about the required attributes for problem solving and decision making. Proponents of each of these theories emphasized certain attributes and the debate appeared to be centered over the importance of knowledge versus heuristic process, or a combination of these two attributes. One author (Glaser, 1984) also mentioned the importance of analogical reasoning. The following section contains these three major theories.

Three Theories of Required Attributes for Problem Solving and Decision Making

1. Knowledge as the Key

Some social scientists theorize that knowledge is the primary element in problem solving and decision making. Newell & Simon (1972) supported this theory:

> Repeatedly, we have found ourselves concerned with the content of the problem solver's knowledge. Behavior is not simply a function of a few aggregative features of this content--of how much content there is, or how it is expressed. Behavior is a function of the specific detail of content, of the actual facts of the particular task in hand. (p. 867)

Their work on human problem solving included a theory of man as an information processing system. They used the computer for problem-solving simulations.

Glaser (1984) reported that evidence from several sources supports the conception that a major component of thinking is the possession of accessible and usable knowledge. He (Glaser, 1985) advocated that rich, domain-specific knowledge is of key importance in problem solving. Glaser (1984) further stated that "the problem-solving difficulty of novices can be attributed largely to the inadequacies of their knowledge bases and not to limitations in their processing capabilities such as the inability to use problem-solving heuristics" (p. 99).

Other supporters of knowledge as a requirement for problem solving were Green, McCloskey, and Caramazza (1985). Their work was in physics and they wrote that many students who take physics courses come to the courses without correctly understanding motion and, therefore, do not correctly solve problems. Hayes (1989) also spoke to the importance of

knowledge of the material in solving problems and wrote a manual to provide the reader with skills to become a better problem solver and to give current information about the psychology of problem solving.

Chase and Simon (1973) discussed theories related to chess skill. They determined that chess skill was dependent upon a vast long-term memory of "knowledge" of information about chessboard patterns. They stated that the most important processes for chess mastery were immediate visual-perceptive processes that called upon this knowledge base and not logical-deductive thinking processes.

Barrows and Feltovich (1987), in support of knowledge, have described the clinical reasoning process for the physician as a model with the following components: (a) patient presentation, (b) generation of multiple hypotheses, (c) hypothesis-oriented inquiry, and (d) problem syntheses. They suggested that students' reasoning difficulties are often due to a deficiency in the knowledge base.

Kurfiss (1988) combined the thoughts of Larkin, Heller, and Greeno (1980), and Simon (1980) when she stated that, "While some general strategies for problem solving may exist, skill in solving most problems depends a great deal on the extent and organization of the knowledge base available to the problem solver" (p. 29). She discussed the fact that knowledge takes many forms and defined one form as "declarative knowledge." Kurfiss stated that this form includes principles, stories, concepts, and other knowledge that is used to make inferences. She defined another type of knowledge as "procedural or strategic knowledge" that she said includes knowing how and when to use declarative knowledge. This type of knowledge really describes what a person can actually do. Examples of this kind of knowledge include knowing how to use

a computer or how to drive a car. Both types of knowledge are useful for problem solving.

2) Heuristic Process as the Key

Wickelgren (1974) believed problem-solving methods to be the important element for solving problems. In his book, he provided examples of various kinds of problems with step-by-step solutions. The text was specifically designed to help the reader increase ability in solving scientific, mathematical, and engineering problems. He believed that general problem-solving methods were especially useful to students in subjects where they did not completely understand the relevant material.

Other proponents of the heuristic process are Whimbey and Lochhead (1982). They developed a program that required thinking aloud to a partner about the steps taken in solving problems. They assumed that subjects made relatively few errors in problem solving due to a lack of knowledge. They believed errors were due to a lack of correct reasoning or failure to approach the problem in a step-by-step manner.

3) Heuristic Process, Knowledge, and Analytical Reasoning Combined

Other writers have emphasized the contributions of a combination of knowledge and the heuristic process in solving problems. Taylor (1965) discussed decision making and problem solving and commented that rationality in decision making is dependent upon both knowledge and the processes of the thinker. Polya (1957), in a book directed toward students and teachers of mathematics, recommended that attention be given to heuristic processes as well as to content. The book guides the reader in a study of the methods of solving mathematical problems. Kurfiss (1988) summarized the ideas of Bransford, Sherwood, Vye, and Rieser (1986); Perfetto, Bransford, and Franks (1983); and Simon (1980), by stating that

"Declarative knowledge alone is necessary but not sufficient for the development of skilled performance. Students must also learn strategies or procedures for using their knowledge and conditions under which specific knowledge is relevant" (p. 29).

Glaser (1985) advocated the importance of both knowledge and process when he stated,

> There appears to be an overemphasis on the instructability of general processes, when recent research also shows the importance of domain-specific and knowledge structure influences on exercising significant forms of problem solving and learning. This course needs to be corrected. Knowledge fosters process, and process generates knowledge. The tale begins and ends with both. (p. 574)

Another idea Glaser (1984) discussed is the importance of inductive or analogical reasoning. He stated that an important component of aptitude and intelligence is knowledge of the solution procedures required for solving a certain task type and he called that ability analogical reasoning. He hypothesized that individuals who have high levels of content knowledge and who also have this analogical reasoning ability are high aptitude individuals.

A Heuristic Process for Decision Making

Janis and Mann (1977) listed seven major characteristics of quality decision making. These heuristic characteristics were extracted from the literature on effective decision making. The authors advocated that if decisions were based on these seven procedural criteria, decision makers would increase the frequency of attainment of their objectives.

> The decision maker, to the best of his ability and within his information-processing capabilities
> 1. thoroughly canvasses a wide range of alternative courses of action;
> 2. surveys the full range of objectives to be fulfilled and the values implicated by the choice;
> 3. carefully weighs whatever he knows about the costs and risks of negative consequences, as well as the positive consequences, that could flow from each alternative;
> 4. intensively searches for new information relevant to further evaluation of the alternatives;
> 5. correctly assimilates and takes account of any new information or expert judgment to which he is exposed, even when the information or judgment does not support the course of action he initially prefers;
> 6. reexamines the positive and negative consequences of all known alternatives, including those originally regarded as unacceptable, before making a final choice;
> 7. makes detailed provisions for implementing or executing the chosen course of action, with special attention to contingency plans that might be required if various known risks were to materialize. (p. 11)

They stated that if a person does not meet one or more of the seven criteria when making an important decision, the decision-making process is defective. The more defects in the process, the more likelihood the decision maker will later experience postdecisional regret.

The Theoretical Model for Clinical Decision Making in Physical Therapy

This debate by educators over the required attributes for problem solving and decision making, plus the documented importance of these skills for physical therapists, led to the development of this model. The model (depicted in Figure 3-1) was designed on the premise that all three theories for problem solving and decision making described earlier have

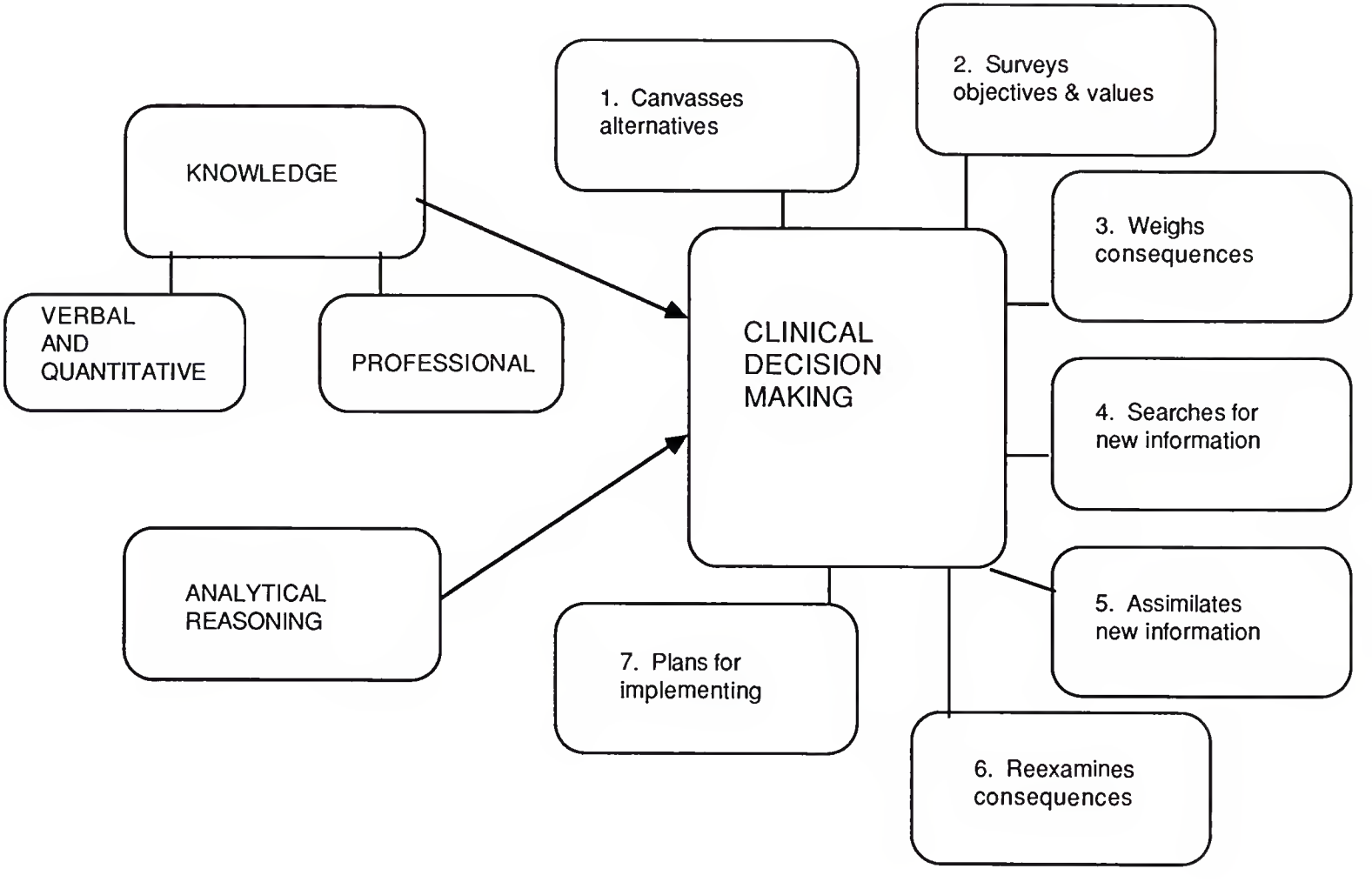

Figure 3-1 THEORETICAL MODEL FOR CLINICAL DECISION MAKING IN PHYSICAL THERAPY

Items 1-7 are adopted from Janis, I. L., & Mann, L. (1977). Decision Making: A Psychological Analysis of Conflict, Choice & Commitment New York: The Free Press.

merit. Physical therapists need an adequate background in general verbal and quantitative knowledge, a strong professional knowledge base, and analytical reasoning ability. This model illustrates that physical therapists must possess these attributes, in addition to having skill in the heuristic process, in order to make quality clinical decisions.

Components of the Model

KNOWLEDGE-

a) Verbal and Quantitative--A combination of general knowledge of words and reading comprehension and mathematical skills, including data interpretation.

b) Professional--Knowledge of physical therapy acquired by participating in a physical therapy program or gained at any time thereafter.

ANALYTICAL REASONING-

The ability to think analytically and logically, including the ability to understand, analyze, and evaluate arguments. Additionally, the ability to understand relationships between persons, places, things, or events and to deduce new information from those relationships.

CLINICAL DECISION MAKING-

The process of using knowledge and analytical reasoning to problem solve and to go through steps or heuristic process to choose among alternative courses of action to make a decision regarding a client.

HEURISTIC PROCESS-

The investigator derived the heuristic process for this model from the work of Janis and Mann (1977) and it includes the following seven steps:

1) Canvasses alternatives
2) Surveys objectives and values
3) Weighs consequences
4) Searches for new information
5) Assimilates new information
6) Reexamines consequences
7) Plans for implementation

Testing the Model

This study was designed to determine the strength of the relation among the model components. Chapter 4, Methodology contains details of the design and the procedure for testing.

Summary

This chapter contains three theories regarding necessary elements for problem solving and decision making. The investigator developed the Theoretical Model for Clinical Decision Making in Physical Therapy to

incorporate the primary elements of each theory because of the belief that knowledge, analytical reasoning, and skill in the heuristic process are equally important in making a clinical decision regarding a client.

CHAPTER 4

METHODOLOGY

This prospective cohort study is an effort to explore the relation among components of the Theoretical Model for Clinical Decision Making in Physical Therapy, developed by this investigator and described in Chapter 3. In order to investigate these relationships, the researcher needed an instrument that would measure decision-making ability. The Clinical Decision Making Scale (CDMS) was chosen for this purpose, with scores obtained on it representing a measure of the heuristic process and decision-making ability.

The investigator also needed quantitative measures of verbal, mathematical and professional knowledge, and analytical reasoning. She used scores obtained on the Graduate Record Examination (GRE) as measures of verbal and quantitative knowledge and analytical reasoning.

The General Test portion of the GRE "yields separate scores for the general verbal, quantitative, and analytical abilities related to success at the graduate level of education" (p. 7, ETS, 1990). The verbal (GRE-V) and quantitative (GRE-Q) subtests of the GRE are measures of verbal and mathematical abilities. Scores from these two measures were combined to provide a composite or GRE-VQ score, representing a global measure of verbal and quantitative knowledge for this study.

The analytical subtest of the Graduate Record Examination (ETS,1990) is a measure of analytical and logical reasoning abilities and the investigator used the score obtained on this subtest to represent analytical reasoning ability. As stated in the GRE Guide to the Use of the Graduate Record Examinations Program (ETS,1990)

> Analytical reasoning questions test the ability to understand a given structure of arbitrary relationships among fictitious persons, places, things, or events and to deduce new information from the relationships given. Logical reasoning questions test the ability to understand, analyze, and evaluate arguments: recognizing the assumptions on which an argument is based, drawing conclusions and forming hypotheses, identifying methods of argument, evaluating arguments and counterarguments, and analyzing evidence. (p. 7)

The Educational Testing Service regularly reports analytical scores as one of the three major component scores of the GRE. They are contained in the same report with the scores of the verbal and quantitative components.

In this study, the physical therapy students' final grade-point averages (GPAs) were the measure of professional knowledge. The final GPA constitutes the cumulative GPA achieved for didactic work in the two years of the physical therapy program.

The investigator then determined the strength of the relationship among the attributes of verbal and quantitative knowledge, professional knowledge, analytical reasoning and the heuristic process or decision-making ability for physical therapy students by using students' GRE-A scores, GRE-VQ scores and students' GPAs as independent variables and students' CDMS scores as the dependent variable. This chapter contains the sample, design, and procedures for data collection and analyses.

Questions and Hypotheses

The questions and hypotheses posed for this study for students about to graduate from master's degree entry-level physical therapy programs were as follows:

1. Is there a relation between posttraining CDMS scores (total or individual subscale) and pretraining GRE-A scores after controlling for GRE-VQ scores and GPA?

Operational Null Hypothesis A

No significant relation exists between GRE-A scores and scores obtained on the CDMS after controlling for effects of other predictor variables.

2. Is there a relation between posttraining CDMS scores (total or individual subscale) and pretraining GRE-VQ scores after controlling for GRE-A scores and GPA?

Operational Null Hypothesis B

No significant relation exists between GRE-VQ scores and scores obtained on the CDMS after controlling for effects of other predictor variables.

3. Is there a relation between posttraining CDMS scores (total or individual subscale) and final GPA for work accomplished in the physical therapy program after controlling for GRE-VQ and GRE-A scores?

Operational Null Hypothesis C

No significant relation exists between final GPA for work accomplished in the physical therapy program and scores obtained on the CDMS after controlling for effects of other predictor variables.

4. Is there a difference in performance on the CDMS instrument among students of various master's degree entry-level physical therapy programs?

Operational Null Hypothesis D

No significant differences exist in scores obtained on the CDMS instrument among students of various master's degree physical therapy programs.

Subjects

The subjects were 244 postbaccalaureate students from six universities that offer master's degree entry-level physical therapy programs. The students were enrolled in their last semester of graduate work and were less than one week from graduation. These subjects were predominantly white and female with a total of 186 women and 58 men. Of the 186 women, 170 were white, 9 were Asian, 3 were Hispanic, 2 were native American, 1 was black and, 1 was oriental. Of the 58 men, 56 were white, 1 was native American, and 1 was Hispanic. The average age of the subjects was 26 $\pm$ 3.55 years.

Procedure

Directors of six master's degree entry-level physical therapy education programs agreed to have their students participate in the study. The investigator selected six programs from the 31 established programs because they represented a cross section of the United States and were

also representative of the specific areas of the United States where the majority (68%) of the 31 programs were located.

Additionally, 23 (74%) of the 31 programs were located in private universities or colleges while eight (26%) were located in state universities. These six programs selected for inclusion in the study reflected the national funding patterns. Four of the six (67%) are housed in private universities and two of the six (33%) are housed in state universities. The programs that participated in this study were the University of Alabama at Birmingham, Birmingham, Alabama; Emory University, Atlanta, Georgia; the University of Southern California, Los Angeles, California; Duke University Medical Center, Durham, North Carolina; Columbia University, New York, New York; and the University of Iowa, Iowa City, Iowa.

After the study was in progress, an additional 13 programs were accredited, elevating the total number of programs in the United States to 44 (APTA, 1990b). The six programs that participated in the study remain representative of both geographical location and institutional funding source. These six programs now represent areas of the country where 88 % of the programs are located. The pattern of institutional funding is currently 27 (62%) privately sponsored programs and 17 (38%) state-supported programs.

Prior to graduation at the respective universities, the investigator sent to the program director or designated representative for each program a packet of materials for each student who had finished didactic and clinical work. Each student packet contained the following items:

1. A cover sheet (Appendix A) for the student's name or identification number. This sheet was removed, to assure the anonymity of each student, before the rest of the forms were returned to the investigator .

2. A copy of the Clinical Decision Making Scale (CDMS) with instructions (Appendix B).

3. An answer form for the CDMS (Appendix C).

4. A biographical information form (Appendix D).

5. A data recording form for reporting final GPA, GRE-Q, GRE-V and GRE-A scores (Appendix E).

The director or a designated faculty representative of each program arranged a meeting of the graduating class during the week before graduation and at that time administered the CDMS to the volunteer students. The students also completed the cover sheet and biographical information forms during that meeting.

The faculty representative collected the forms from the students and recorded the requested GRE and GPA data on the data recording forms. Before returning all completed forms to this investigator for analysis, the faculty representative removed the cover sheets to assure student anonymity. Upon receiving the materials, the investigator coded the data by university.

Data Analysis

The researcher performed data management and statistical analyses using the StatView ™ 512 + (1986) statistical analysis system. The analyses generated descriptive data on students from all programs combined and for each program individually. The relation between the three independent variables, students' GRE-A scores, GRE-VQ scores and GPAs, and the dependent variable, students' CDMS scores, was determined with multiple regression analyses. The computer program generated five

independent multiple regression analyses using the three independent variables in each and using the CDMS total scores or the CDMS subscales A, B, C, and D scores respectively as the dependent variable. Pearson product-moment correlations were also computed between the independent variables and the CDMS scores. The alpha levels for the tests of significance were set at .05.

The investigator determined differences in student performance among programs on the CDMS (total scores and the four subscale scores) using five one-way ANOVAs. The alpha level for the test of significance for the CDMS total score was set at .05. Because the ANOVAs were repeated for each of the four subscales, the alpha levels for the tests of significance of the subscales were set at .01.

Instrumentation

The researcher used scores from two different instruments in the study. This section contains a description of these two instruments.

Clinical Decision Making in Nursing Scale (CDMNS)

The CDMNS is a 40-item scale with a range of possible scores of 40-200. A higher score represents a higher quality of clinical decision making. The instrument was designed to measure decision-making process as compared with an effective, normative process described by Janis and Mann (1977). The CDMNS was first published and copyrighted by Jenkins in 1983 as the Clinical Decision Making in Nursing Scale. The author (Jenkins, 1983) granted permission to this investigator to change the name to Clinical Decision Making Scale (CDMS) for the purpose of this study to avoid confusion when used by a health professional other than a nurse. No

changes were made in the 40 items because the items, as presently constituted, are appropriate for assessing clinical decision-making process for anyone in a health related area. The CDMS is not a timed test but has been shown to require between 20-25 minutes for completion.

The instrument was originally designed to measure how nursing students perceived their own clinical decision-making ability. The Likert-type scale had choices ranging from 5 (strongly agree) to 1 (strongly disagree). Jenkins later revised the scale descriptors from 5 (always) to 1 (never), to better reflect self-perceived decision-making behavior rather than perceived ability.

The CDMS is subdivided into four subscales of the decision-making process:

Subscale A: Search for Alternatives and Options

Subscale B: Canvassing of Objectives and Values

Subscale C: Evaluation and Reevaluation of Consequences

Subscale D: Search for Information and Unbiased Assimilation of New Information

The range of possible scores for each subscale is 10-50.

Jenkins first established content validity of the CDMS by designing the instrument based on the literature regarding decision making. She then pretested the instrument, critiqued it for congruity and clarity of test items, and had nurse education experts evaluate and rate each item again for content validity. She used a specification matrix with criteria formulated by Nunnally and Durham (1975). She retained each item receiving a total matrix score of 70-77 % agreement (Jenkins, 1985).

The instrument was determined to have an internal consistency reliability of 0.83 as assessed using Cronbach's alpha. The standardized-

item alpha is 0.85 (Jenkins, 1985). Two other investigators have used the instrument and reported Cronbach's alphas of 0.80 (McFadden, 1986) and 0.93 (Engberg, 1987) for their studies.

The scoring system for the instrument involves a weighting scale with 22 of the 40 CDMS items weighted as positive and 18 of the items weighted as negative. The 40 items are further separated into the four subscales. Using the scoring key provided by Jenkins, this investigator scored the instrument for each participant in the study. Each participant received a CDMS total score and a score for each of the four subscales.

Graduate Record Examination (GRE)

The Educational Testing Service (ETS, 1990) developed and publishes the GRE. The General Test portion of the GRE "yields separate scores for the general verbal, quantitative, and analytical abilities related to success at the graduate level of education" (p. 7). The GRE General Test requires 3 hours and 30 minutes of testing time, and scores are based on the number of correct answers. Each examinee receives a separate score within a range of 200-800 for each of the three measures.

The analytical measure is the newest of the three measures. ETS developed it to test abilities other than verbal and quantitative. Investigators have shown that analytical ability is related to success in graduate work (ETS, 1990). The measure was instituted in October, 1977 and revised in October, 1981. This revised measure includes items to test analytical and logical reasoning (ETS, 1990).

The test makers designed the verbal measure to test knowledge of words and reading comprehension. They employed four types of questions in this measure: antonyms, analogies, sentence completion, and reading comprehension (ETS, 1990).

ETS designed the quantitative measure to test mathematical skills. They used three types of questions in this measure: discrete quantitative questions, data interpretation questions, and quantitative comparison questions (ETS, 1990).

Reliability data for the General Tests were determined using the Kuder-Richardson Formula (20). Reliability coefficients for the General Tests, based on a sample of 2,435 examinees, were 0.91 for the verbal measure, 0.92 for the quantitative measure, and 0.89 for the analytical measure (ETS, 1990).

CHAPTER 5

RESULTS

Introduction

This study was designed to investigate the relation among components of the Theoretical Model for Clinical Decision Making in Physical Therapy and the decision-making ability of students in master's degree entry-level physical therapy programs. This investigator developed the model after a review of literature revealed a variety of theories regarding attributes required for quality decision making. Chapter 3 contains a discussion of the model and Figure 3-1 depicts it. The investigator examined the physical therapy students' GRE-VQ scores, GRE-A scores, final GPAs for work in the physical therapy program, and students' CDMS total and subscale scores to determine possible relationships. She used the data from the six physical therapy programs to apply Pearson correlation procedures and five multiple regression models to address this issue.

A second purpose of the study was to determine whether a significant difference existed among the performances of students from various physical therapy programs on the CDMS instrument. The investigator used five one-way analysis of variance procedures to determine any differences on the total and four subscale CDMS scores.

Relationships Between GRE-VQ Scores, GRE-A Scores, GPAs, and CDMS Total and Subscale Scores

The investigator tested for the relation between a measure of verbal and quantitative knowledge, a measure of analytical skill, a measure of professional knowledge, and a measure of clinical decision-making process ability, by computing five multiple regression analyses. The same three independent variables--students' GRE-VQ scores, GRE-A scores and physical therapy program GPAs--made up each of the five multiple regression analyses. The dependent variable was different for each analysis and was the students' CDMS total scores in the first analysis and subscale A, B, C, or D scores respectively in the other four analyses. The researcher computed Pearson product-moment correlations to compare each independent variable with each dependent variable.

These analyses were used to test the following null hypotheses:

Null Hypothesis A

No significant relation exists between GRE-A scores and scores obtained on the CDMS after controlling for effects of other predictor variables.

Null Hypothesis B

No significant relation exists between GRE-VQ scores and scores obtained on the CDMS after controlling for effects of other predictor variables.

Null Hypothesis C

No significant relation exists between final GPA for work in the physical therapy program and scores obtained on the CDMS after controlling for effects of other predictor variables.

As indicated in Tables 5-1 - 5-5, the multiple regression analyses with 241 subjects did not yield significant ($p < .05$) predictor variables of clinical decision making ability. Consequently, the investigator could not reject any of the three null hypotheses. Beta coefficients were not reported due to lack of significance.

Table 5-1
Multiple Regression of CDMS Total Score Model

Source	*SS*	*df*	*MS*	*F*	*p*	R^2
Model	145.8	3	48.6	.569	.64	.007
Error	20251.9	237	85.5			
Total	20397.7	240				
GRE-VQ Score	113.8	1	113.8	1.3	.25	
GRE-A Score	.9	1	.9	.01	.92	
GPA	31.1	1	31.1	.36	.55	

Table 5-2
Multiple Regression of CDMS-A Score Model

Source	*SS*	*df*	*MS*	*F*	*p*	R^2
Model	12.3	3	4.1	.609	.61	.008
Error	1595.9	237	6.7			
Total	1608.2	240				
GRE-VQ Score	6.2	1	6.2	.918	.34	
GRE-A Score	.5	1	.5	.082	.77	
GPA	5.6	1	5.6	.827	.36	

Table 5-3
Multiple Regression of CDMS-B Score Model

Source	*SS*	*df*	*MS*	*F*	*p*	R^2
Model	11.3	3	3.8	.344	.79	.004
Error	2591.2	237	10.9			
Total	2602.5	240				
GRE-VQ Score	6.1	1	6.1	.556	.46	
GRE-A Score	4.2	1	4.2	.385	.54	
GPA	1.0	1	1.0	.091	.76	

Table 5-4
Multiple Regression of CDMS-C Score Model

Source	*SS*	*df*	*MS*	*F*	*p*	R^2
Model	15.1	3	5.0	.404	.75	.005
Error	2952.2	237	12.5			
Total	2967.3	240				
GRE-VQ Score	14.4	1	14.4	1.2	.28	
GRE-A Score	.01	1	.01	.001	.98	
GPA	.70	1	.70	.056	.81	

Table 5-5
Multiple Regression of CDMS-D Score Model

Source	*SS*	*df*	*MS*	*F*	*p*	R^2
Model	15.9	3	5.3	.71	.55	.009
Error	1772.9	237	7.5			
Total	1788.8	240				
GRE-VQ Score	3.7	1	3.7	.492	.48	
GRE-A Score	2.9	1	2.9	.394	.53	
GPA	9.3	1	9.3	1.2	.27	

The Pearson product-moment correlations between the independent variables--students' GRE-VQ scores, GRE-A scores and physical therapy GPAs and the dependent variables--students' CDMS total and subscale scores were not significant at the .05 alpha level, further substantiating the inability to reject any of these three null hypotheses. As indicated in Table 5-6, the GRE-VQ scores were negatively, but not significantly, correlated with CDMS total and subscale scores. A negative nonsignificant correlation was

Table 5-6
Correlation Matrix for all Eight Variables

	GRE-A	GPA	GRE-VQ	CDMS T	CDMS A	CDMS B	CDMS C	CDMS D
GRE-A	1							
GPA	.183 (.004)	1						
GRE-VQ	.506 (.0001)	.085 (.19)	1					
CDMS T	-.044 (.50)	.024 (.71)	-.075 (.25)	1				
CDMS A	-.047 (.46)	.041 (.53)	-.062 (.34)	.752 (.0001)	1			
CDMS B	-.059 (.36)	.002 (.97)	-.048 (.46)	.776 (.0001)	.42 (.0001)	1		
CDMS C	-.034 (.60)	-.019 (.77)	-.070 (.28)	.788 (.0001)	.488 (.0001)	.456 (.0001)	1	
CDMS D	.012 (.85)	.063 (.33)	-.045 (.48)	.722 (.0001)	.463 (.0001)	.439 (.0001)	.368 (.0001)	1

p value in ( )

found between GRE-A scores and CDMS total, subscale A, subscale B and subscale C scores, and a positive nonsignificant correlation was found between GRE-A scores and CDMS subscale D scores. Correlations between physical therapy students' GPAs and CDMS scores were all positive and nonsignificant with the exception of GPA and CDMS subscale C scores which was negative and nonsignificant.

The correlation between the independent variables GRE-VQ scores and GRE-A scores was positive and significant, as were the correlations between the dependent variables CDMS total and subscale scores. The independent variables GPA and GRE-VQ scores were positively, but not significantly, correlated. However, a positive significant correlation was demonstrated between GPA and GRE-A scores.

Difference in Performance of Students on the CDMS Instrument by Physical Therapy Program

The investigator used five one-way analysis of variance procedures to determine whether students from the various physical therapy programs performed differently on the CDMS. She ran the first procedure comparing programs with CDMS total scores using an alpha level of .05 and the subsequent analyses comparing programs with CDMS subscale scores using an alpha level of .01. She used these analyses to test Null Hypothesis C--there will be no significant relation between final GPA for work in the physical therapy program and scores obtained on the CDMS. As indicated in Table 5-7, the analyses revealed no significant differences in performance

on the CDMS among students from various programs; thus this null hypothesis could not be rejected.

Table 5-7
Five One-Way ANOVAS Comparing Six Physical Therapy Programs on CDMS Total and Subscale Scores

Source	*df*	*SS*	*MS*	*F*	*p*
CDMS-T	5	254.067	50.813	0.587	0.709
ERROR	238	20590.261	86.514		
CDMS-A	5	28.365	5.673	0.842	0.521
ERROR	238	1604.373	6.741		
CDMS-B	5	37.765	7.553	0.693	0.629
ERROR	238	2595.395	10.905		
CDMS-C	5	52.388	10.478	0.843	0.520
ERROR	238	2959.841	12.436		
CDMS-D	5	58.711	11.742	1.575	0.167
ERROR	238	1773.957	7.454		

Descriptive Data for Total Students and for Students From Each Physical Therapy Program

The descriptive data for all students in the study revealed an average age of 26 ± 3.50 years; an average GRE-VQ score of 1152 ± 125.5; an average GRE-A score of 613 ± 87.0; an average GPA of 3.50 ± 0.26; an average CDMS-T score of 151 ± 9.26; an average CDMS-A score of

38 ± 2.60; an average CDMS-B score of 38 ± 3.30; an average CDMS-C score of 38 ± 3.52; and an average CDMS-D score of 38 ± 2.75. These data are reported in Table 5-8. The descriptive data for students from each of the six individual programs are reported in Appendices F - K.

Table 5-8

Descriptive Data Summary for All Students

VARIABLE	*N*	*M*	*SD*	Mode	Low	High	Range
AGE	242	26	3.50	24	22	42	20
GRE-VQ	241	1152	125.5	1150	770	1560	790
GRE-A	241	613	87.0	630	370	800	430
GPA	244	3.50	0.26	3.60	2.82	4.00	1.18
CDMS-T	244	151	9.26	156	123	176	53
CDMS-A	244	38	2.60	---	31	46	15
CDMS-B	244	38	3.30	37	28	47	19
CDMS-C	244	38	3.52	38	26	47	21
CDMS-D	244	38	2.75	38	30	45	15

Summary

The results of the data analyses did not support rejection of any of the four null hypotheses formulated for testing. Chapter 6 contains a discussion of these findings, their implications, and suggestions for further research.

CHAPTER 6

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

A review of the relevant literature revealed the need for a better understanding of the attributes required for quality decision making in physical therapy. Based on the literature, the investigator developed the Theoretical Model for Clinical Decision Making in Physical Therapy, discussed in detail in Chapter 3. The present investigation was designed to study the relation between components of this model--knowledge, analytical reasoning ability, and decision-making ability--for students approximately one week away from graduation from a master's degree entry-level physical therapy program. In addition, the researcher intended this investigation to answer the question of whether students from various physical therapy programs with varying numbers of classroom hours in instruction in problem solving and decision making would perform differently on an instrument designed to measure decision-making ability.

The analysis was an examination of the relationships between the components of the model investigated in two ways. Five multiple regression analyses used the same three independent variables--students' GRE-VQ scores, GRE-A scores, and GPAs for work in the physical therapy program. The dependent variables for the analyses were the students' CDMS total

scores or subscale A, B, C, or D scores respectively. These analyses revealed no significant relation between the independent and dependent variables. Pearson product-moment correlations were also computed between the independent and dependent variables and were not significant at the .05 alpha level.

Before discussion of these results, the researcher wishes to share an excerpt from an article by Shulman and Elstein (1975):

> The tendency of intuitive statisticians to overemphasize positive information, information that supports a belief or reflects a positive co-occurrence of two variables, is also consistent with findings from research in concept attainment. Failure to give adequate weight to negative instances of a concept has been noted by Bruner et al., (1956), Bourne (1966), and, most convincingly, by Wason (1968). Recognition of these human tendencies for self-deception in the processing of information are not new discoveries by contemporary psychologists. They have merely provided experimental confirmation of the observations made several centuries ago by Francis Bacon in a discussion of the "idols of the mind."
>
> "The human understanding when it has adopted an opinion, either as being the received opinion or as being agreeable to itself, draws all things else to support and agree with it. And though there be a greater number and weight of instances to be found on the other side, yet these it either neglects and despises, or else by some distinction sets aside, and rejects; in order that by this great and pernicious predetermination the authority of its former conclusions may remain inviolate. And therefore it was a good answer that was made by the man who was shown hanging in a temple a picture of those who had paid their vows as having escaped shipwreck. They would have him say whether he did not now acknowledge the power of the gods--'Aye', asked he again, 'but where are they painted that were drowned after their vows?'
>
> . . . it is the peculiar and perpetual error of the human intellect to be more moved and excited by affirmatives than by negatives; whereas it ought properly to hold itself indifferently disposed toward both alike. Indeed in the establishment of any true axiom, the negative instance is the more forcible. (Bacon, cited in Curtis and Greenslet, 1962, pp. 16-17.)". (p. 24)

With these thoughts in mind, although no significant relation was discovered among the variables in the model, several explanations for the findings may apply. Determining adequate measures of the various model

components was a challenge and one or more of the quantitative variables used to represent the components verbal and quantitative knowledge, professional knowledge, analytical reasoning ability, and decision-making ability, may not accurately represent those components.

1. Verbal and quantitative scores obtained on the Graduate Record Examination (GRE-VQ), while accepted as valid predictors for success in the first year of graduate school (ETS, 1990), may not accurately represent verbal and quantitative knowledge for this model. Additionally, although GRE-A scores were shown to be valid predictors of success in master's degree entry-level physical therapy programs (Day, 1986), they may not accurately represent analytical reasoning ability in this model.

2. Although a student's physical therapy program final GPA can be considered a quantitative measure of professional knowledge, it does not represent every aspect of the student's professional knowledge. For example, knowledge gained on clinical rotations that are graded on a pass/fail basis is not included in the GPA. Also, GPA cannot account for life experiences.

3. The scores obtained on the CDMS may not be an accurate representation of clinical decision-making ability.

(a) These scores are based on self-report and, even though students were assured anonymity, they may have answered as they felt the investigator would want them to answer.

(b) The students may not be aware of their real decision making behavior.

(c) The physical therapy curriculum may not have emphasized decision-making terms and process, resulting in poor perception and understanding by the physical therapy students.

Additionally, the students may have had little actual opportunity for independent decision making while in the physical therapy program. Even though all had completed their clinical internships and were about to graduate, many students may not have been allowed to make clinical decisions while on internships, or may have taken decision making lightly, knowing that the ultimate decision always rested with the clinical instructor. Students may also have had poor role models in the clinics. No studies have documented the expertise of clinical instructors in the decision-making process.

Another explanation for the nonsignificant findings of the study may be the fact that little variability existed in the sample. The sample was made up of graduate physical therapy students who were quite homogeneous by virtue of the fact that each student was competitively selected from a large applicant pool. They, in fact, have passed through more than one selection process before making it into the physical therapy program. They were selected for admission to a four-year institution to obtain their bachelor's degrees, then selected into graduate school, and finally selected into the physical therapy program. The narrow range of GPAs for this sample must be considered when interpreting the results. The final GPA range for didactic course work in the physical therapy program for all students combined was 2.82 - 4.00 with a mean of 3.50 ± 0.26 and a mode of 3.60. This narrow range makes prediction difficult, as Willingham (1974) has documented.

The results of five one-way ANOVAs indicated no significant differences in performance on the CDMS among students from different physical therapy programs. These findings are interesting because the programs do not cover the topics of problem solving and decision making in

the same way. When asked to list the number of classroom hours devoted to these topics, the program directors were unable to do so, and indicated that the topics are covered in parts of many of the courses. Only one program had an entire course devoted to these topics at the time of the study and one other program has since instituted such a course. There may be several reasons for the fact that no significant differences in student performance were found among programs.

1. Clinical decision making may actually be learned only during clinical internships when students have real opportunities to practice the skill. If this is the case, then not much difference between students' clinical decision-making abilities would be expected because programs are similar with regard to practice time. Each of the six programs includes a minimum of 18 weeks of full-time clinical experiences for the students and the programs offer comparable internships. Even though the didactic portions of the programs are different, the actual clinical decision practice time in the clinic in the various programs is similar.

2. The students' scores on the CDMS may reflect an innate decision-making ability that has nothing to do with the physical therapy program. May and Newman (1980) postulated that students enter the physical therapy program with a developed approach to problem solving. Perhaps the time spent in the program does not affect the decision-making ability of the students.

3. Another possible explanation is that because problem solving and decision making are considered prerequisites for quality practice in physical therapy, and because these topics are interwoven throughout the curricula of these physical therapy programs, the students may be getting continual exposure to both regardless of the physical therapy program.

Conclusions and Recommendations

Because physical therapists are now able to practice independently without practitioner referral in 24 states, being able to problem solve and make quality clinical decisions has become increasingly important. A better understanding of the clinical decision-making process and attributes required for quality decision making is imperative. Although the data in this study did not substantiate the Theoretical Model for Clinical Decision Making in Physical Therapy that this investigator developed, many possible reasons for these findings were discussed earlier. One important conclusion that must not be ignored is that, for this sample, there was no significant relation between components of this model and clinical decision-making ability. Although a believer in the importance of these non-significant results, this researcher would advocate strongly for more study of this model based on the previous discussion. The investigation of other possible models in the future is also important.

One recommendation would be to investigate other quantitative measures of knowledge and analytical reasoning to use in evaluating this model. For example, perhaps some quantitative measure could be developed for the professional knowledge component that would include the important clinical internship work that is graded on a pass/fail basis and therefore not included in a student's GPA.

The use of the licensure examination for the physical therapist is one such idea because this instrument has a section that requires incorporation of clinical knowledge. Using the licensure examination score as the measure of professional knowledge would necessitate that the study be

done after graduation instead of immediately prior to graduation, but it would incorporate a quantitative measure that represents the knowledge required to practice physical therapy. All states require that graduates of physical therapy programs pass this examination before being allowed to practice physical therapy. These licensure examination scores are confidential and participants in the study would have to agree to release them to the investigator.

Another idea would be to study those physical therapists who have become certified clinical specialists in an area of physical therapy. The American Physical Therapy Association currently recognizes seven clinical specialties:

1. Pediatrics
2. Orthopedics
3. Neurology
4. Sports
5. Electrophysiology
6. Cardiopulmonary
7. Geriatrics

The use of a sample of these specialty certified physical therapists in testing the model would enable the investigator to use scores that these participants achieved on the Clinical Specialist Examination as the quantitative measure for professional knowledge in the model. It would also enable the researcher to test for differences in decision-making abilities of therapists in different clinical speciality areas.

The Watson Glaser Critical Thinking Appraisal (CTA) is another instrument that might be used to measure analytical reasoning ability. Scores obtained on this instrument could then replace the GRE-A score as

the quantitative measure of analytical reasoning for the model. The CTA could be administered to those agreeing to participate in the study at the same time they take the CDMS.

More research with the CDMS is also recommended as follows:

1. Administer the CDMS to the same subjects that participated in this study after they have completed one year of full-time employment as physical therapists to determine whether clinical decision-making ability changes after actual "on the job" experience. Experience may improve decision-making ability.

2. Administer the CDMS to a group of physical therapists who have practiced physical therapy for at least ten years, and who are considered by their peers to be experts in the field, to determine whether these therapists score significantly higher than did the new graduates. This would further delineate the role of experience in clinical decision making and help establish baseline scores for different levels of therapists.

3. Administer the CDMS to a sample of clinical instructors who, by definition, have at least two years of clinical experience, to determine whether a significant difference exists in scores for this group compared with the new graduates. These clinical instructors are supposed to be role models for students and should therefore be better decision makers than the new graduates.

4. Administer the CDMS to graduate students in other disciplines to compare performances among students in a variety of health disciplines. For example, studying graduate students from occupational therapy programs, nursing programs, and physician assistant programs as well as physical therapy programs would be interesting.

5. Administer the CDMS to a group of students about to graduate from entry-level master's degree physical therapy programs and to a group about to graduate from entry-level baccalaureate programs. This would allow the investigator to determine differences in decision-making ability among graduates of these two types of entry-level physical therapy programs. The avenues of entry into the physical therapy profession are currently just the two types of programs. Forty-four entry-level master's degree programs and 87 baccalaureate programs are currently accredited. Whether or not the first professional degree for the physical therapist should be at the graduate level is a controversial topic in the physical therapy profession. Evaluating differences in clinical decision-making ability among graduates of these two types of professional programs would be of interest to physical therapy educators.

6. Administer a teaching module with guidance in problem solving and decision making to half of a physical therapy class and not to the other half and, at the end of the semester, compare results obtained on the CDMS between groups. This would help determine the role of "teaching" in clinical decision making.

7. Design a final eight-week clinical internship for physical therapy students in which they are given structured opportunities to practice clinical decision making. Administer the CDMS to this group of physical therapy students before the final internship and again after the eight-week experience to see if scores on the instrument change significantly post internship. Before this internship could be arranged, the researcher would have to educate the clinical staff in the process of decision making and set specific objectives to be covered, to assure that members of the staff felt comfortable with this specific role of mentorship for decision-making skill.

Another recommendation for future research is that someone develop another instrument to measure clinical decision-making process or ability. This would allow comparison of performance on both instruments. The new instrument would also provide an alternative quantitative measure of decision-making ability for use in further investigation of the Theoretical Model for Clinical Decision Making in Physical Therapy.

The final recommendation for further study is in the area of admission criteria for physical therapy programs. Interest in prediction of successful applicants to programs in physical therapy has developed because of the many qualified applicants competing for each of the available slots and because of the current shortage of physical therapists. Because the need for physical therapists keeps increasing, graduation of each student admitted to a physical therapy program is imperative. These students must also become effective problem solvers and clinical decision makers.

Gross (1989) examined multiple physical therapy admission criteria and their value for predicting didactic, clinical, and licensure performance. He studied academic and licensure records of three classes of graduates of three baccalaureate programs. He reported that preprofessional GPAs and standardized measures of general verbal and mathematic aptitude were moderate predictors of physical therapy GPA and weak predictors of licensure performance. None of the admission criteria significantly predicted clinical performance. Because clinical decision making is inherent in clinical performance, perhaps these admission criteria could be investigated for their ability to predict performance on the CDMS or another instrument designed to measure clinical decision-making ability.

Many ideas for future investigations have been generated by this study. Although implementing some of the ideas would be difficult, the task

should be undertaken due to the importance of gaining a better understanding of the clinical decision-making process in physical therapy. The challenge of independent practice by physical therapists is a reality. The profession must continue to make every effort to guarantee that each physical therapist is ready to meet the challenge.

APPENDIX A

COVER SHEET FOR STUDENT'S NAME
OR IDENTIFICATION NUMBER

NAME_____

NUMBER_____

This sheet will be removed before the Clinical Decision Making Scale is sent to me. It is necessary for you to put your name on this sheet so that a member of your faculty can provide me with your GRE scores and your GPA. I will not ever know you by name. Thank you for helping me with my dissertation.

Sincerely,

Jane A. Day, PT, MA
PhD Candidate

APPENDIX B

THE CLINICAL DECISION MAKING SCALE

Adapted from The Clinical Decision Making in Nursing Scale * with permission of Helen M. Jenkins, PhD.

Directions for the Clinical Decision Making Scale

For each of the following statements, think of your behavior while caring for clients. Answer on the basis of what you are doing now in the clinical setting.

There are no "right" or "wrong" answers. What is important is your assessment of how you ordinarily operate as a decision maker in the clinical setting. None of the statements cover emergency situations.

Statements are listed beginning on the following page. Use the answer sheet provided. Do not dwell on responses. Circle the answer that comes closest to the way you ordinarily behave.

Answer all items. About twenty minutes should be required to complete this exercise.

Scale for the CDMS

Circle whether you would likely behave in the described way:

A - Always - What you consistently do every time.
F - Frequently - What you usually do most of the time.
O - Occasionally - What you sometimes do on occasion.
S - Seldom - What you rarely do.
N - Never - What you never do at any time.

Sample statement: I mentally list options before making a decision.

Key: A (F) O S N

The circle around response F means that you usually mentally list options before making a decision.

Clinical Decision Making Scale

Note: Be sure you respond in terms of what you are doing in the clinical setting at the present time.

1. If the clinical decision is vital and there is time, I conduct a thorough search for alternatives.

2. When a person is ill, his or her cultural values and beliefs are secondary to the implementation of health services.

3. The situational factors at the time determine the number of options that I explore before making a decision.

4. Looking for new information in making a decision is more trouble than it's worth.

5. I use books or professional literature to look up things I don't understand.

6. A random approach for looking at options works best for me.

7. Brainstorming is a method I use when thinking of ideas for options.

8. I go out of my way to get as much information as possible to make decisions.

9. I assist clients in exercising their rights to make decisions about their own care.

10. When my values conflict with those of the client, I am objective enough to handle the decision making required for the situation.

11. I listen to or consider expert advice or judgment, even though it may not be the choice I would make.

12. I solve a problem or make a decision without consulting anyone, using information available to me at the time.

13. I don't always take time to examine all the possible consequences of a decision I must make.

14. I consider the future welfare of the family when I make a clinical decision which involves the individual.

Note: Be sure you respond in terms of what you are doing in the clinical setting at the present time.

15. I have little time or energy available to search for information.

16. I mentally list options before making a decision.

17. When examining consequences of options I might choose, I generally think through "If I did this, then...".

18. I consider even the remotest consequences before making a choice.

19. Consensus among my peer group is important to me in making a decision.

20. I include clients as sources of information.

21. I consider what my peers will say when I think about possible choices I could make.

22. If an instructor recommends an option to a clinical decision making situation, I adopt it rather than searching for other options.

23. If a benefit is really great, I will favor it without looking at all the risks.

24. I search for new information randomly.

25. My past experiences have little to do with how actively I look at risks and benefits for decisions about clients.

26. When examining consequences of options I might choose, I am aware of the positive outcomes for my client.

27. I select options that I have used successfully in similar circumstances in the past.

28. If the risks are serious enough to cause problems, I reject the option.

29. I write out a list of positive and negative consequences when I am evaluating an important clinical decision.

Note: Be sure you respond in terms of what you are doing in the clinical setting at the present time.

30. I do not ask my peers to suggest options for my clinical decisions.

31. My professional values are inconsistent with my personal values.

32. My finding of alternatives seems to be largely a matter of luck.

33. In the clinical setting I keep in mind the course objectives for the day's experience.

34. The risks and benefits are the farthest thing from my mind when I have to make a decision.

35. When I have a clinical decision to make, I consider the institutional priorities and standards.

36. I involve others in my decision making only if the situation calls for it.

37. In my search for options, I include even those that might be thought of as "far out" or non-feasible.

38. Finding out about the client's objectives is a regular part of my clinical decision making.

39. I examine the risks and benefits only for consequences that have serious implications.

40. The client's values have to be consistent with my own, in order for me to make a good decision.

Thank you for being a participant in this study. Do you have any ideas about decision making in physical therapy that were not covered by the scale that you would like to share? You can speak to specific items or give any general comments you would like. Feel free to use this last page or the back of the answer sheet.

APPENDIX C

ANSWER SHEET FOR THE CLINICAL DECISION MAKING SCALE

Answer Sheet for the Clinical Decision Making Scale

Directions: After reading each statement, circle the response which comes closest to the way you act or behave. Please do not skip any of the items.

Remember that:
A - Always
F - Frequently
O - Occasionally
S - Seldom
N - Never

1.	A	F	O	S	N	21.	A	F	O	S	N
2.	A	F	O	S	N	22.	A	F	O	S	N
3.	A	F	O	S	N	23.	A	F	O	S	N
4.	A	F	O	S	N	24.	A	F	O	S	N
5.	A	F	O	S	N	25.	A	F	O	S	N
6.	A	F	O	S	N	26.	A	F	O	S	N
7.	A	F	O	S	N	27.	A	F	O	S	N
8.	A	F	O	S	N	28.	A	F	O	S	N
9.	A	F	O	S	N	29.	A	F	O	S	N
10.	A	F	O	S	N	30.	A	F	O	S	N
11.	A	F	O	S	N	31.	A	F	O	S	N
12.	A	F	O	S	N	32.	A	F	O	S	N
13.	A	F	O	S	N	33.	A	F	O	S	N
14.	A	F	O	S	N	34.	A	F	O	S	N
15.	A	F	O	S	N	35.	A	F	O	S	N
16.	A	F	O	S	N	36.	A	F	O	S	N
17.	A	F	O	S	N	37.	A	F	O	S	N
18.	A	F	O	S	N	38.	A	F	O	S	N
19.	A	F	O	S	N	39.	A	F	O	S	N
20.	A	F	O	S	N	40.	A	F	O	S	N

APPENDIX D

BIOGRAPHICAL INFORMATION SHEET

Last 4 Digits of SS#_____

BIOGRAPHICAL INFORMATION

SEX:_____MALE_____FEMALE

AGE:_____YEARS

RACE:

_____AMERICAN INDIAN
_____ASIAN
_____BLACK
_____CAUCASIAN
_____HISPANIC
_____ORIENTAL
_____OTHER (write in)

PRIOR DEGREE(S): MAJOR AREA(S)(ie: lib.arts;psychology;etc):
(Check and write in all that apply)

_____AA _____
_____AS _____
_____BA _____
_____BS _____
_____MA _____
_____MS _____
_____OTHER (write in) _____

APPENDIX E

DATA RECORDING FORM

To be filled out by school faculty:

Final GPA_____

GRE Quantitative Score_____

GRE Verbal Score_____

GRE Analytical Score_____

THANK YOU !!

APPENDIX F

DESCRIPTIVE DATA SUMMARY FOR PROGRAM A STUDENTS

VARIABLE	*N*	*M*	*SD*	Mode	Low	High	Range
AGE	92	26	2.77	24	22	39	17
GRE-VQ	94	1161	110.0	---	980	1500	520
GRE-A	94	606	79.2	550	420	800	380
GPA	94	3.42	0.26	---	2.82	3.90	1.08
CDMS-T	94	152	10.3	156	123	176	53
CDMS-A	94	39	2.76	40	31	46	15
CDMS-B	94	38	3.51	37	28	47	19
CDMS-C	94	38	4.02	38	26	47	21
CDMS-D	94	37	2.80	38	31	45	14

APPENDIX G

DESCRIPTIVE DATA SUMMARY FOR PROGRAM B STUDENTS

VARIABLE	*N*	*M*	*SD*	Mode	Low	High	Range
AGE	22	26	3.98	24	23	41	18
GRE-VQ	19	1101	126.3	---	850	1340	490
GRE-A	19	599	103.2	---	380	740	360
GPA	22	3.61	0.25	---	3.04	4.00	0.96
CDMS-T	22	149	7.78	---	135	164	29
CDMS-A	22	38	2.04	---	34	42	8
CDMS-B	22	37	2.57	39	33	42	9
CDMS-C	22	37	2.97	---	31	42	11
CDMS-D	22	38	3.06	36	32	45	13

APPENDIX H

DESCRIPTIVE DATA SUMMARY FOR PROGRAM C STUDENTS

VARIABLE	*N*	*M*	*SD*	Mode	Low	High	Range
AGE	36	27	3.54	25	24	38	14
GRE-VQ	36	1095	144.5	---	770	1460	690
GRE-A	36	603	92.6	---	370	800	430
GPA	36	3.66	0.20	---	3.00	3.97	0.97
CDMS-T	36	152	8.72	153	138	173	35
CDMS-A	36	39	2.88	36	32	45	13
CDMS-B	36	37	2.77	36	32	43	11
CDMS-C	36	38	3.52	36	30	45	15
CDMS-D	36	38	2.19	---	34	44	10

APPENDIX I

DESCRIPTIVE DATA SUMMARY FOR PROGRAM D STUDENTS

VARIABLE	*N*	*M*	*SD*	Mode	Low	High	Range
AGE	30	26	2.54	24	24	34	10
GRE-VQ	30	1118	124.0	---	910	1410	500
GRE-A	30	613	91.0	590	420	760	340
GPA	30	3.59	0.26	---	2.93	3.97	1.04
CDMS-T	30	150	8.40	156	132	163	31
CDMS-A	30	39	2.42	38	33	44	11
CDMS-B	30	37	3.04	38	30	43	13
CDMS-C	30	37	2.69	37	33	43	10
CDMS-D	30	37	3.22	38	31	43	12

APPENDIX J

DESCRIPTIVE DATA SUMMARY FOR PROGRAM E STUDENTS

VARIABLE	*N*	*M*	*SD*	Mode	Low	High	Range
AGE	25	27	4.91	23	23	39	16
GRE-VQ	25	1188	132.0	---	930	1540	610
GRE-A	25	600	93.0	---	460	800	340
GPA	25	3.37	0.22	---	2.93	3.74	0.81
CDMS-T	25	153	8.94	---	135	167	32
CDMS-A	25	39	2.75	38	34	45	11
CDMS-B	25	38	4.22	34	30	45	15
CDMS-C	25	38	3.25	---	30	42	12
CDMS-D	25	38	1.96	39	35	42	7

APPENDIX K

DESCRIPTIVE DATA SUMMARY FOR PROGRAM F STUDENTS

VARIABLE	*N*	*M*	*SD*	Mode	Low	High	Range
AGE	37	26	4.55	--	23	42	19
GRE-VQ	37	1218	102.0	1200	1030	1560	530
GRE-A	37	656	76.3	680	410	790	380
GPA	37	3.48	0.21	--	3.00	3.85	0.85
CDMS-T	37	152	8.77	162	133	166	33
CDMS-A	37	38	2.17	---	33	43	10
CDMS-B	37	38	3.12	---	31	43	12
CDMS-C	37	38	3.24	---	33	43	10
CDMS-D	37	37	2.82	36	30	43	13

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BIOGRAPHICAL SKETCH

Jane Ann Day was born in Pensacola, Florida on September 25, 1946. She grew up in Perdido Beach, Alabama and was graduated from Foley High School in Foley, Alabama in 1964. She earned a Bachelor of Science degree in physical therapy from the University of Alabama in 1968 and a Master of Arts degree in education from the University of Alabama at Birmingham in 1974.

Jane practiced as a physical therapist in Birmingham, Alabama for nine years before becoming an assistant professor in the Department of Physical Therapy at the University of Florida where she taught for 10 years. She has been employed parttime in physical therapy working in pediatrics at Shands Hospital since 1988.

During her career as a physical therapist , Jane has been actively involved in the American Physical Therapy Association (APTA) at both state and national levels. She has served in many capacities including vice-president and president of the Alabama chapter of the APTA. She was appointed to the Committee on Physical Therapy Education for the APTA from 1987-1989 and has served as a member of the pool of On-Site Visitors for Accreditation of Physical Therapy Programs since 1976.

Her hobbies include travel in the United States, Canada, and abroad, playing golf, and reading.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

James W. Hensel, Chair
Professor of Educational Leadership

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Forrest W. Parkay
Professor of Educational Leadership

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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May, 1991

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